

1. (Three Times Amended) A battery comprising a battery body including:
a positive electrode and a negative electrode each containing an active material, where
the positive electrode and the negative electrode each has an uneven surface defining a space;
an electrolytic solution containing an electrolyte [,]; and
an adhesive resin layer which is interposed in between the positive electrode and the
negative electrode and is joined directly to both [of] the positive electrode and the negative
[electrodes] electrode, wherein
the adhesive resin layer consists of one layer and contains an adhesive resin and a filler;
the adhesive resin layer fills the space defined by the uneven surface of the positive
electrode and the space defined by the uneven surface of the negative electrode;
a weight ratio of the adhesive resin to the filler is not less than 1/5; and
the adhesive resin layer is connected to the positive electrode and the negative electrode
at a predetermined peel strength.

Please add new Claim 16-18 as follows:

--16. (New) A battery according to claim 1, wherein the predetermined peel strength is
not less than 50 gf/cm.

17. (New) The battery according to claim 1, wherein the particles size of the filler is not
more than 0.1 μm .

18. (New) The battery according to claim 1, wherein the weight ratio of the adhesive
resin to the filler is not less than 1/5 and not more than 2.--

MARKED-UP COPY OF AMENDMENTS

IN RE APPLICATION OF:

SHIGERU AIHARA ET AL

SERIAL NO: 09/381,295

FILED: SEPTEMBER 22, 1999

FOR: BATTERY

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: EXAMINER: DOVE, T.

: GROUP ART UNIT: 1745

: CPA FILED: OCTOBER 22, 2001

AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

In response to the Office Action filed January 2, 2002, the period for response having been extended to June 2, 2002, by a petition for extension of time filed herewith, please amend the application identified above as follows (marked-up copy of amendments attached):

IN THE CLAIMS

Please cancel Claim 4 without prejudice to or disclaimer of the subject matter therein.

Please amend Claim 1 as follows:

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SUPPORT FOR THE AMENDMENTS

This Amendment cancels Claim 4; amends Claim 1; and adds new Claims 16-18. Support for the amendments is found in the specification and claims as originally filed. In particular, support for Claim 1 is found in the specification at least at page 13, lines 12-14; and at page 38, Table 3, Example 7. Support for new Claims 16-17 is found in the specification at least at page 36, Table 2. Support for new Claim 18 is found in the specification at least at page 38, Table 3, Example 6. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-3 and 5-18 will be pending in this application. Claims 1 and 8 are independent.

REMARKS

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Applicants thank the Examiner for the indication that Claim 8 is allowable. Office Action at page 2, line 4.

Claims 1-7, 9-10 and 14-15 are rejected under 35 U.S.C. §102(e) over U.S. Patent No. 6,096,456 ("Takeuchi"). Applicants respectfully traverse the rejection because the cited prior art fails to disclose, teach or suggest the independent Claim 1 limitations that "the adhesive resin layer consists of one layer and contains an adhesive resin and a filler; the adhesive resin layer fills the space defined by the uneven surface of the positive electrode and the space defined by the uneven surface of the negative electrode; a weight ratio of the adhesive resin to the filler is not less than 1/5; and the adhesive resin layer is connected to the positive electrode and the negative electrode at a predetermined peel strength".

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. MPEP §2131.

The present invention provides a light, compact and thin battery in which a positive and a negative electrode are joined firmly to maintain the adhesive strength while securing both electron insulation and ion conduction between electrodes and decreasing resistance between electrodes, i.e., internal resistance of a battery, to improve battery characteristics.

Specification at page 4, lines 8-15. The battery according to the invention comprises an adhesive resin layer which is interposed in between the positive and negative electrode.

Specification at page 4, lines 17-21. The positive electrode and the negative electrodes are directly bonded to the adhesive resin layer. Specification at page 5, lines 1-2.

In contrast to the claimed invention, Takeuchi discloses batteries comprising a separator. Takeuchi discloses the polymer for use in the separator may include polyvinylidene fluoride. Takeuchi at column 14, lines 5-27. Takeuchi discloses that the separator may be a composite film with any other support. Takeuchi at column 16, lines 53-55. Takeuchi discloses a support including alumina particles. Takeuchi at column 18, lines 8-10.

However, Takeuchi fails to disclose, teach or suggest the independent Claim 1 limitations that "the adhesive resin layer consists of one layer and contains an adhesive resin and a filler; the adhesive resin layer fills the space defined by the uneven surface of the positive electrode and the space defined by the uneven surface of the negative electrode; a weight ratio of the adhesive resin to the filler is not less than 1/5; and the adhesive resin layer is connected to the positive electrode and the negative electrode at a predetermined peel strength".

Because Takeuchi fails to disclose all the limitations of independent Claim 1, the

rejection under 35 U.S.C. §102(e) over Takeuchi should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the rejection.

Claims 1-7 and 9-15 are rejected under 35 U.S.C. §102(e) over U.S. Patent No. 6,287,720 ("Yamashita"). Applicants respectfully traverse the rejection because Yamashita fails to disclose, teach or suggest the independent Claim 1 limitations that "the adhesive resin layer consists of one layer and contains an adhesive resin and a filler; the adhesive resin layer fills the space defined by the uneven surface of the positive electrode and the space defined by the uneven surface of the negative electrode; a weight ratio of the adhesive resin to the filler is not less the 1/5; and the adhesive resin layer is connected to the positive electrode and the negative electrode at a predetermined peel strength".

Yamashita discloses a battery comprising a positive electrode comprising a cathode active material layer, a negative electrode comprising an anode active material layer, and a sole porous separator disposed between the positive electrode and the negative electrode, wherein the positive electrode, the negative electrode and the separator are disposed in a casing containing an electrolyte. Yamashita at abstract.

In conventional batteries, such as that of Yamashita, a battery body is put in a metal-made case so that the positive electrode, the negative electrode and the separator can be brought into intimate contact by the pressure of the case thereby to maintain the contact between each electrode and the separator. Specification at page 1, line 21 to page 2, line 3. Electrodes have their surfaces smooth by pressing but still have unevenness of several microns to form vacancies where a separator and the electrodes are not in contact. Specification at page 3, line 24 to page 4, line 1. The vacancies that should have been filled with an electrolyte may get starved of the electrolyte, which depends on the amount of the electrolyte supplies and the condition of use of the battery. Specification at page 4, lines 2-4.

- Starvation of the electrolyte leads to an increase of internal resistivity of the battery and reductions in battery characteristics. Specification at page 4, lines 5-7.

However, the filler-containing adhesive resin layer of the present invention has such a form as to fill the space existing on the surface of each electrode due to the surface unevenness, so that the adhesive strength increases, and reduction in battery characteristics due to shortage of the electrolyte can be prevented. Specification at page 13, lines 13-16.

According to the present invention, an adhesive resin layer is provided between a positive electrode and a negative electrode. In order to bond one electrode to the other, a predetermined adhesion strength (peel strength) is required.

However, the Examples shown in Yamashita fail to disclose a sufficient amount of PVDF to bond a positive electrode to a negative electrode to form a battery body. Yamashita just discloses only enough PVDF to bond the filler particles to each other in a separator. To overcome this deficiency, Yamashita relies on a casing to press together the positive electrode, the separator and the negative electrode. However, Yamashita fails to suggest forming a laminated battery without a casing, which is possible according to the present invention.

The attached Fig. A shows comparison results between the Examples of the present invention and Yamashita regarding adhesion strength. Fig. A shows that the estimate peel strength of Yamashita is much lower than that of the present invention.

The present invention uses a filler of extremely fine particles. The use of the fine particles increases a weight ratio of the adhesive resin to the filler. Moreover, the adhesive resin layer fills the space due to the surface unevenness on each of the positive and the negative electrodes. Accordingly, the adhesion points between the adhesive resin and the electrodes increases to improve the peel strength (adhesion strength). See attached Fig. B.

The fine filler particles of the present invention disperse in chainlike form to improve the electrolyte retention ability because of capillary phenomena. This improves the ion conductivity and reduces the internal resistance of the battery.

Because Yamashita fails to disclose the independent Claim 1 limitations that "the adhesive resin layer consists of one layer and contains an adhesive resin and a filler; the adhesive resin layer fills the space defined by the uneven surface of the positive electrode and the space defined by the uneven surface of the negative electrode; a weight ratio of the adhesive resin to the filler is not less than 1/5; and the adhesive resin layer is connected to the positive electrode and the negative electrode at a predetermined peel strength", the rejection under 35 U.S.C. §102(e) over Yamashita should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the rejection.

New Claim 16 is further patentable over the cited prior art, because the cited prior art fails to suggest the Claim 16 limitation that "the predetermined peel strength is not less than 50 gf/cm".

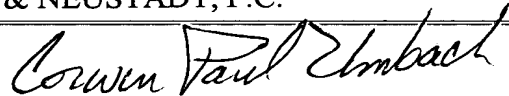
Pursuant to M.P.E.P. §821.04, Applicants respectfully request examination of method Claim 14, which includes all of the limitations of product Claim 1.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Attachment:

Marked-up copy of amendments
Figs. A and B



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